The role of stellate ganglion induced repolarization heterogeneities in post-myocardial infarction arrhythmias: A computational approach

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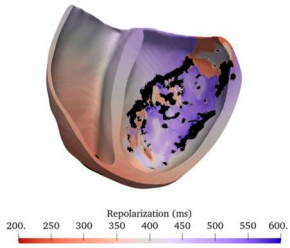
Background: The sympathetic nervous system innervates the heart through the left and right stellate ganglia. These ganglia shorten repolarization in complementary regions, specifically the posterior and left lateral walls compared to the anterior and right lateral walls. Sympathetic denervation, achieved by removing the left stellate ganglion, is a promising treatment for post-infarction arrhythmias in some patients but not all. It is debated whether bilateral stellate ganglia removal is more effective in preventing arrhythmia than the removal of only the left stellate ganglion.

Aim: Here we employ a computation approach to investigate the effect of both the right and left stellate ganglia on post-infarction arrhythmias.

Methods: Patient-specific computational models of the ventricles of two patients who suffered myocardial infarction were constructed from magnetic resonance images with late gadolinium enhancement; one with the scar in the region of the anterior wall and the other with the scar in the posterior region of the left ventricle. For these cases we simulated right and left stellate ganglion stimulation, respectively, by increasing the conductance of the slow delayed rectifier current (IKs) and consequently reducing the duration of the action potential. We performed stimulation protocol and analyzed vulnerability to reentrant arrhythmias.

Results: Each case was simulated with and without considering sympathetic innervation stimulation. Activation and repolarization maps (see figure) were computed from our simulations, so that exit sites for reentry initiation could be predicted, with higher predisposition in the case of stellate ganglion remodeling.



Conclusion: The results indicate that action potential duration shortening exerted by sympathetic stimulation predisposes the induction of reentrant arrhythmias. Thus, sympathetic denervation may offer a more specific alternative antiarrhythmic therapy than the use of cardioverter-defibrillators (ICDs), highlighting its potential in preventing fatal post-myocardial infarction arrhythmias.